Comments: Eutrophication Indicator Thresholds Protective of Biological Integrity in California Wadeable Streams

Accuracy of estimated relationships

The causal relationship between biostimulatory factors and changes in the stream macroinvertebrate and algal assemblages has been established (as indicated by the references cited in the manuscript). However, the accuracy of the estimated relationship (i.e., the quantitative agreement between the estimated relationship and the "true" causal relationship) is of critical importance for the application of thresholds derived from this analysis. As I see it, two options are available:

1. Use the thresholds from the bivariate logistic regressions described in the manuscript strictly for assessment. That is, exceedance of a threshold for TN or TP is an indication of a high likelihood of a biological assemblage that is not meeting its goals. Once streams are identified as being impaired, then a more involved, stream-specific analysis is conducted to identify the appropriate remediation action.
2. Improve the accuracy of the estimated relationship by accounting for strong covariates. Strong covariates can be identified as other stressors that are strongly correlated with nutrients (TN and/or TP) and with the response variable. The effects of these covariates can be controlled by stratifying the dataset into groups with similar values of each covariate. Turbidity is one variable to consider in this regard.

We are unlikely to eliminate all sources of uncertainty regarding the accuracy of the estimated relationships, but it would be good to provide transparency regarding the effects of this uncertainty on the final management decisions.

Threshold and constraint models

The interaction between these threshold models and Beck's landscape models needs careful consideration. Beck's models predict constraints on biological condition based on landscape characteristics, but these landscape characteristics can also give rise to increased nutrients. For example, the proportion of agricultural land use is one predictor variable in Beck's model, and one pathway by which agricultural land use can affect stream biota is via increased nutrients. If Beck's model is used to identify the potential range of biological conditions, it seems possible that stream reaches that could benefit from reductions in nutrients will be a priori be designated as constrained.

My understanding is that Beck's models are intended to predict constraints on biological condition that are not related to pollutant load, but as they are currently formulated, pollutant load is included as one important pathway linking the predictor variables in the model to biological condition. Consideration of the full conceptual model, and thinking through the relationships between land cover, pollutant loads, and biological condition may help design a system of models that captures both constraints and pollutant effects.

Uncertainty in eutrophication variables

Much of the difference in the performance of different eutrophication variables in predicting biological condition can likely be attributed to differences in measurement uncertainty for each of the eutrophication variables. A variable such as percent algal cover would be expected to much more temporally variable and measured with much more uncertainty than TN, and therefore, models estimated with percent algal as a predictor will yield broader confidence intervals than TN. It would good to control for the effects of uncertainty in the predictor variable in these models, so that comparisons of model performance would be more meaningful.

Logistic vs. continuous regression

Reconsider the use of logistic models. When continuous response variables are categorized into a binary outcome, information is lost. It's not clear to me that advantages of running logistic models outweighs this loss of information.

Metric sensitivity

Evaluating the relative sensitivity of different metrics (e.g., ASCI vs. CSCI) to nutrient enrichment is challenging from a conceptual perspective. How do we quantitatively define metric sensitivity? Steepness of initial response? Most precise relationship? Think about metric sensitivity with regard to final management decision, and then potentially incorporate this thinking in the comparisons of different thresholds for different metrics.